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ABSTRACT

Discussed in this report is a technique used in cross-cultural research for measuring cognitive processes in children and youth. The research strategy aims at evaluating the subject's performances on problem solving tasks by having subjects become active agents in the discovery process while experimenters remain as passive and neutral as possible. The subject is asked to solve a problem by asking questions to get the information he or she needs to reach a solution. The subject becomes an active searcher; the experimenter only provides the information requested. The subject's tactics indicate how he or she deals with the structure of the problem. Thinking about a problem becomes a way of making explicit and communicable to oneself or to others its logical structure. If this is so, it is of interest to know how subjects belonging to different cultural settings process problems, and the influence that their structure and the symbolic system used (manner of presentation) have on tactics. The subject's performance can then by analyzed in terms of the set of logical rules that he or she uses and of the symbolic systems that favor or hamper problem solving performance. (CS)

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COGNITIVE ASPECTS OF PROBLEM SOLVING

(Round Table on "Problems in the Use of Diagnostic Instruments with Children and Youth of Widely Varied Cultural Backgrounds" - A.P.A. Annual Meeting, New Orleans)

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The study of cognitive processes has been receiving valuable information from cross cultural studies. This raises some known theoretical and methodological issues to some of which we will refer in this presentation (1,2).

We are now conducting cross cultural research following two main approaches: 1°) the classical, applying traditional types of instruments, assumptions and formulations, to compare U.S. and Argentine samples of adolescents in tests like Thurstone's PMA, Cattell's 16 PF and Holtzman Inkblot Technique (3,4,5); and, 2°) another approach that assumes other premises that pertain to the conditions that should be taken into account in the study of psychological processes. It is to the latter that we will refer in what follows.

It is easy to hypothesize similarities or differences in cognitive processes between cultural groups. But it is not so easy to demonstrate that those hypotheses have or have not been experimentally verified. The difficulty is only partially methodological, and has to do with experimental and theoretical aspects and with the interpretation of results.

The use of instruments "adapted" from another culture raises a host of issues only partially answered. It is interesting to observe that experimenters, seldom if ever, have problems that are meaningful - in what they consider a "less" developed culture - adapted to test subjects in a more "advanced" one. This is an indication of how strong cultural components may be in determining the direction and priorities in this type of research. But contrarywise, it is also valid to wonder how strong and how influential are the so called cultural variables. In some cases, differences within a culture may be greater than differences between cultures.

Within a limited range of cognitive studies, we will suggest a course of action that may help to overcome some of these problems, by centering upon the subject rather than upon the experimenter. By a cognitive process we mean the sequence of events and operations that occur when solving a problem. It is assumed that we can identify these events and these operations and that the subject recognizes the existence of a problem. Situation A may be a problem for some subjects, but others may not recognize it as such. In cross cultural research it is crucial that the subject be aware or recognizes the existence of a problem. In turn, the experimenter decides that the subject has encountered a problem because in trying to solve it he brings about, combines, discards and operates in a sequential and directional manner various items of information. Since different processes may precede the same answer we may conclude that the exclusive study of final answers is not a very safe approach to the understanding of cognitive processes. It may be wondered to what an extent differences between theories

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of cognition depend on the experimenter's set of inferences rather than on what subjects do. In summary, to study processes, processes must be studied.

In 1953 we developed a technique that apparently helps to solve some of the above mentioned difficulties (6,7,8). The subject is asked to solve a problem by asking questions to get the information needed to reach an aswer. The subject becomes an active searcher and the experimenter only provides the information requested. The sequence of questions is a tactic. Tactics begin with the first question and end when no further questions are asked. It is assumed that there is a correspondence between psychological processes and observed tactics. The implications and theoretical bases of this assumption have been dealt with elsewhere (9). In other words, the presentation of the situation recognized by the subject as a problem sets in motion a temporally ordered sequence of observable events that correspond to the psychological process. The comparative study of these tactics permits to infer agreements and differences between processes and to discover vicarious ways of dealing with problems.

The variable order acquires foremost significance and weights differentially the information provided by the answer to the questions asked. Unfortunately, we do not know how to have subjects process a problem with maximum freedom "pari-passu" with a well controlled experimental situation that minimizes the role of the experimenter. The compromise we reached is as follows: typically, the subject is given a set of cards, in one of which the problem is presented. The instructions state that in order to reach the solution, the subject may ask as many questions as he desires and deems necessary. The questions that he may ask are presented on cards and the answers to them are provided on the reverse side of the corresponding card. Picking up a card and looking at the corresponding answer is equivalent to asking a question. Other presentations have been used; for instance, opening a box is equivalent to a question the answer to which is given by the box content, or erasing a blank space so that the answer appears and so on. Using this approach the subject does not generate the questions. We have experimented with problems in which subjects generated their questions. They had to identify a certain area in a given drawing, or to find out the symbolic system used to name that area, etc.

We have explored a variety of content areas such as: clinical diagnostic ability (10,11), process in Rorschach interpretation (12,13), problem solving processes in pathological conditions (14,15,16,17) and training in problem solving (18,19,20,21,22). Some studies dealt with autonomic indexes (23,24,25) and with the effects of pharmacobgical agents in problem solving processes (26,27). A good number of studies had to do with educational and developmental aspects of problem solving. Some of these studies resulted from the cooperation from colleagues and students in U.S., Argentina and Switzerland.

In 1962 (28), while working in cognitive processes in the solution of mathematical problems, it became clear that it was desirable to specify in each problem: a) the relational system - logical structure - inherent to the problem, for instance a completely ordered set or a logical tree, etc.; and b) the symbolic system used to express it. A problem becomes a function of the logical structure and of the symbolic system used to express it (29,30). In some cases, given a problem, it is possible to identify experimentally its structure

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as appraised by the subjects by the sequence of questions asked. But also, given abstract relationships, it is possible to make them concrete by using a specified symbolic system; for instance, every day language, abstracts symbols, perceptual and concrete presentations, etc. This makes it possible to build isomorphic problems that having the same structure are realized using different symbolic systems (31).

The subject's tactics indicate how he deals with the structure of the problem. Thinking about a problem, becomes a way of making explicit and communicable to oneself or to others its logical structure. If this is so, it is of interest to know how subjects belonging to different cultural settings process problems, and the influence that their structure and the symbolic system used (manner of presentation) have on tactics.

Tactics can be evaluated at the subject and at the sample levels. After trying various approaches we now center on the comparison of each individual tactic with the ideal one. Ideal tactics are those that arrive at solution by maximizing information at every step, are not redundant, do not present order reversals - in terms of logical relations - do not include irrelevant information, and reduce uncertainty to zero. Deviation from these conditions bring about a lower score than the one corresponding to the ideal tactic. Clearly, subjects may agree among themselves in the tactics they follow and still not follow the ideal one. Since ideal tactics result from the application of "occidental" rules, it is worthwhile to find out if this set of rules is followed by subjects that belong to other cultures. Thus far, this seems to be the case. If further evidence demonstrates the opposite, it will help to understand the relational systems that prevail in different cultural groups. For such purposes, problems should be presented using a symbolic system that is understood by the subject. We are not assuming that the logic used in deriving ideal tactics is the best or the only one but we are using it only as a landmark. In other words, experimental results indicate how subjects unravel a logical structure and how this process can be or cannot be interpreted in terms of established rules.

Our experience has generated several questions that have to do with developing new problems and with theoretical issues that are crucially present in cross cultural research. For instance, is it possible to find out experimentally if there are other logical relations than the ones we know? How do symbolic systems relate to logical systems? How many or which relations are enbedded in a language and how does this language hamper or facilitate making explicit the relations that underline a problem? We have evidence pointing to the fact that temporal precedence - order - does make a difference in spelling out relational systems, that uncertainty reduction is partially a function of order and of the symbolic system used and that some symbolic systems have greater adaptability at the risk of being more redundant; for instance, every day language.

Several studies have shown how certain symbolic systems become of signal importance at certain ages (32). For instance, at around ten to eleven years of age ordinary verbal language begins to facilitate problem solution when compared with a symbolic system based on the manipulation of concrete objects or perceptual symbols. Further, from nine to seventy nine years of age we found a constant difference in scores between isomorphic problems presented using ordinary language and abstract symbols (33). In studying prelingually deaf children (34,35)

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both in Argentina and in U.S., it has been possible to show that their problem solving tactics do not differ from those of normal children if the problems are presented using a symbolic system that they can handle. The threshold of efficiency in operating with a symbolic system is of basic importance. If subjects are not proficient in handling a language nothing can be concluded about their ability to operate with the logical relations inherent to a problem presented in that language (36).

However, the problem is more complex than what it seems. In many cases it is possible to use a given structure and dress it in several symbolic systems -- from where one would conclude about their experimental independence. But the tactics used by subjects solving these isomorphic problems indicate that certain symbolic systems facilitate the processing of some problems while others make it harder. This suggests that a certain symbolic system may be inappropriate to deal with a given structure and not with another.

At the present time we are studying problem solving tactics in primitive groups in Paraguay and Bolivia. The logical structure of the problems is based on logical trees of varied complexity presented using a board on which several paths among trees and huts have been indicated. The subject is told that he has to find a lost pig - or horse. He may know whether the lost animal has or has not transited on a certain path by removing a small piece of the board. If prints of the hoofs appear, then the animal in question has passed by. Those problems are isomorphic to others that we have used in U.S. and in Argentina. Unfortunately, the data we have right now available are not complete but it seems as if: given that subjects recognize a problem and understand the symbolic system used, their tactics show minor differences with those followed by other groups in corresponding isomorphic problems.

We have here restrained from discussing perceptual and personality correlates of Problem Solving. These will be discussed in a forthcoming book (37).

In summary: research strategy should be based on the subject's performances rather than on the experimenter's assumptions, having subjects as free as permissible and experimenters as passive and neutral as possible. Final answers to problems are not a safe way to infer processes, rather ways to identify the sequence of events (tactics) that preceed the answer to a problem should be preferred. A crucial element in describing these sequences is order. The subject -- not the experimenter - should perceive the experimental situation as a problem, and decide which information to request and how to process it. His performance can then be analyzed in terms of the set of logical rules that he uses and of the symbolic systems that favour or hamper his problem solving performance. For this purpose it is important to have some experimental problems in which the structure and the symbolic system used are well defined, so that preferred ways and vicarious ways of dealing with the problem can be safely identified. Many of these observations agree with findings that have to do with language theory and experimental logics.

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